Knowledge Management System in SMEs within stable Enterprise Networks

LUCA CAGNAZZO, LORENZO TIACCI, VANESSA ROSSI
Dipartimento di Ingegneria Industriale
Università degli Studi di Perugia
Via G. Duranti 67, 06125 Perugia
ITALY
luca.cagnazzo@gmail.com

Abstract: - Companies need to respond to ever-changing and increasing customer demands in order to maintain a stable market position. In this scenario, collaboration among companies is one of the most promising strategies for enhancing global competitiveness. New business models as well as new theories about governance, operations, strategies and management have been in the process of being developed in last years for these emerging Enterprise Networks. To achieve effective cooperation within a collaborative environment, the development of a Knowledge Management System is nowadays essential, since the facing up with the actual knowledge-based market. This paper provides a structured methodology to establish a Knowledge Management System in a Small and Medium Enterprise that actively contributes in a stable and long term strategy enterprise network through an Action Research approach. The Action Research (AR) is conducted in a medium company, named Si.Ca.RT, belonging to an Italian network of 21 enterprises

Key-Words: - SME, Knowledge Management, Enterprise Network, Performance Measurement.

1 Introduction

Cooperation among enterprises represents one of the most fruitful and possible ways of development for modern capitalism [9]. Cooperating means to co-invest to be able to offer winning products and services on the global market. Through the mutual sharing of resources and knowledge, firms can aspire to increase their competitive position within the market. [1] argue that intense interactions among firms, together with external sources of technical information, increase the probability that this information is used for developing innovations with a high degree of novelty. Thus, collaboration allows to obtain a large variety of resources which permit to create new combinations of technologies and knowledge [41]. For these reasons, consolidated collaboration forms such as firm aggregations in stable Enterprise Networks (ENs) have been increasing in recent years. Globalization is considered one of the major factors which have recently promoted network creation [47]. Several authors consider networks, and alliances more in general, as the greater sources of innovation and new knowledge creation [55], because collaboration among partners increases the probability to create and develop new products, services or processes [57] . Thus, collaborating with partners to find different resources is becoming a critical task in networked organizations [33][21]. The differences in the partner knowledge facilitates the innovative processes allowing the formations of new associations and-or new links [12][62][44][57]. These advantages could be particularly important for Small & Medium Enterprises (SMEs) because of the resource constraints and limitations they work within [19]. However, success of an EN depends on the effective acquisition, integration, management and sharing of information and knowledge in business activities at all EN stages [65]. Knowledge has become one of the critical driving forces for business successes. Organizations are becoming more knowledge intensive, by hiring "minds" more than "hands", and the needs for leveraging the value of knowledge are increasing [64]. This is particularly true for ENs, since the most important motives of mutual collaboration are, among others, access to information, resources, markets and technologies [22]. A structured management of information, know-how, skills, expertise, capabilities as well as all tangible and intangible assets of the overall collaborative environment is an important goal to achieve in order to increase the company's

competitiveness. Thus, Knowledge Management (KM) is an important task to be pursued by ENs, since it has a tremendous effect on competitiveness, and the assumption 'the more knowledge management capability you have, the more competitiveness you possess' has been verified in literature [37]. Several studies have been developed theories, methodologies and frameworks [39] regarding KM adoption in single companies and much more have investigated the importance of KM in single businesses. Nevertheless, very few studies discuss the application or implementation of the KM within ENs and no articles on new models or frameworks for implementing a Knowledge Management System (KMS) in ENs are available. Thus, given the importance of KM especially for these new forms of collaboration and the scarcity of existing material in literature on this topic, this article presents a structured methodology for establishing a KMS in ENs. For this purpose a reference framework is presented in the article, considering the Critical Success Factors (CSFs) for implementing a Knowledge Management System (KMS) and a Knowledge Management and Measurement System (KMMS) as fundamental tasks for a successful implementation. The research methodology adopted by the authors is an Action Research (AR), through which the framework is applied and tested within an Italian SME, named Si.Ca.RT that belongs to an Italian EN, Gruppo Poligrafico Tiberino (GPT). The AR allows the authors to assess the developed theory, measuring how the company and the network performances are modified by the KMS implementation. Thus, the goal of the research can be summarized in three main steps, as suggested by Fig.1.

2 Networking: a need for SMEs competitiveness

SMEs have to make changes in the form of their organizations and of doing business in order to evolve and adapt to a knowledge-based economy. These changes have to include the creation of inter-organizational cooperation. The most usual type of cooperation is an association between its own suppliers and clients or cooperation with other companies in the same sector or geographical region. Network analysis is an approach to the analysis of cooperation among companies, which has increased greatly in recent years, especially in the form of Virtual Organizations (VOs). The analysis of this type of organization gives three principal sources of value social structure, learning and generation of external economies in the network [34]. Research in cooperated systems has contributed to characterizing the following benefits for SMEs correlated to the relationship of cooperation among companies [35][43][40][30][29]: increment of the market share; improvement of efficiency in using the company's assets; improvement of the level of services offered to clients; time reduction in developing a new product; sharing and cost reduction correlated to the development of new products; reduction of risks in relation to failure in the development of a new product; improvement of the quality of a product; improvement of the level of competence and acquaintances inside the company; possibility to take advantage in a more effective way of company economies; reduction of stocks; facilitating access to the market; more effective credit access, facilitating the communication with financial institutes since the potential presence of a sole interlocutor, i.e. the central proactive actor of the network (if there is one), that represents all the collaborative environment; finally collaboration with other companies within formalized and structured long term-strategy networks increases the company's ratings with banks. Conversely, networking of enterprises entails new organizational problems, such as the decentralization of decision-making process and the horizontal coordination between different business functions as well as, outside the firm, between complementary activity performed by suppliers and customers [17][16]. Thanks to the these up and coming business models, theories about governance, operations and management are being created. KM represents the base to allow the ENs to achieve the objectives explained above.

3 Knowledge Management: concepts and evolutions

There are many definitions of knowledge [27] however, most are specific to the context in which they are used. From the KM perspective, [14] that knowledge is a fluid mix of framed experiences, values, contextual information and expert insight which provide a framework for evaluating and incorporating new experiences and information. While [50], from an engineering perspective, define knowledge as the whole body of data and information that people bring to bear to practical use in action, in order to carry out tasks and create new information. Although both have a slightly

different definition for knowledge, their focus is the same: knowledge is a resource that needs to be managed; KM systems are seen as a way to take advantage of opportunities for exchanging and sharing knowledge. The study of knowledge dates back to ancient Greece. Even before then, knowledge was at least implicitly managed as people performed the job. Early hunters, for example learned the best skills and practices for successful hunting. These skills and techniques were transmitted from one generation to the next. This illustrates the transfer of knowledge, a KM activity [61]. The actual study of knowledge management is much more recent. Like the study of communication, it has roots in many other areas of study—business, management, sociology, and economics to name just a few. Literature on this matter has exponentially evolved throughout the years and different classifications, concepts and meanings of KM have been developed. For example, [42] distinguishes between tacit and explicit knowledge. Discussions on this distinction are abundant in the KM literature [64]. The more recent interest in organizational knowledge has prompted the issue of managing the knowledge possessed by an organization for its benefit. Such interest has given rise to the creation of a new perspective for the KM that views KM as a discipline for identifying and leveraging the collective knowledge in an organization to help the organization be competitive [56]. One major issue therefore would be the effectiveness of Knowledge Management Systems (KMS) in enhancing effectiveness and productivity of knowledge workers in creating competitive knowledge. [60] teaches how KM is comprised of both objective and subjective elements, and hence a KMS must be able to cater for both. In another study, [3] explain that the availability, source and flow of information are the product of human processes rather than of information technology. With this evolution, the focus starts to move on intangible assets and on the collaboration among subjects as the source of new knowledge. In recent years, the concept has been extended to different economical subjects and KM is starting to be investigated in collaborative environments and ENs. Knowledge sharing enterprises able to establish trustworthy and cooperative relationships with other organizations will be well positioned for developing sustainable competitive advantages [10]. There is now a widely held view, particularly amongst the authors who have focused on knowledge sharing in interrelationships adopting a network perspective [54][24][46], that knowledge exchange facilitates improved performance within the network [20]. Organizations can learn from each other and benefit from new knowledge developed by other organizations. [45] have formulated a new multi-methodology for knowledge management in collaborative environments, consisting of four iterative steps supported by appropriate strategic information systems. However, the main parts of the articles on this matter give insights only in particular aspects, such as the implementation of common IT system [38], the information access control [10], or focused on trust [26] or partner reputation [11]. Notwithstanding its importance, there are no articles that investigate the adoption of a KMS in ENs considering all the factors to achieve this goal. A new structured methodology has been developed in this article and presented in the next paragraphs.

4 The proposed framework: learning from Action Research

In this section, the approach for establishing a KMS in a company belonging to an EN is presented. In particular the KMS for organizing and managing the knowledge should be implemented in the overall network: this implies that global KMS for the network should be implemented directly through the KMSs of the individual companies. Thus, in order to implement a global KMS in the GPT network, firstly a local KMS should be applied in every company.

The methodology proposed by the authors to achieve this result is the Action Research (AR). As defined by [4] in this approach "The action researcher is not an independent observer, but becomes a participant, and the process of change becomes the subject of research". [59] emphasizes the importance of this approach in building theory in complex situations, arguing that "the grounded, iterative, interventionist nature of AR ensures closeness to the full range of variables in setting where those variables may not all emerge at once" and that "AR requires us to be creative, because, it is usually conducted to develop a new approach or solution to a situation for which there is no existing prescription".

In developing the AR in Si.Ca.RT and in implementing the KMS within the GPT collaborative environment, the authors followed the 8 major characteristics of the AR methodology, as descripted also by [23]:

1- Action researcher not limited to observation but to take action;
2- AR involves two goals: problem solving and contribution to science;
3- AR require cooperation between the researchers and the client personnel;
4- AR aims at developing holistic understanding and recognition of complexity;
5- AR is fundamentally about the comprehension and investigation of change;
6- Ethical issues have to be understood since the close cooperation between the researchers and the client personnel;
7- AR includes all types of data gathering methods;
8- The action researcher should have a pre-understanding of the company business and environment.

The framework for establishing a KMS in ENs is so proposed by the authors in Fig. 2 (adapted from [18]).
The framework is structured respecting four distinct Knowledge phases:

1. Knowledge Identification: an understanding of the working environment and the key concepts, Key Performance Indicators (KPIs) and the Critical Success Factors (CSFs) for implementing the KMS are performed;
2. Knowledge Representation: the representation of the knowledge findings, through the CSF communication to the network, is achieved;
3. Knowledge Transfer: the implementation of the CSFs in the network partners is achieved;
4. Knowledge Measurement: the assessment of the identified KPIs and the CSF refining follow.

As mentioned above, the methodology proposed by the authors follows the AR approach and its typical phases are clearly distinguishable in the framework. As discussed by [13] the AR cycle comprises three types of step: a pre-step to understand context and purpose; six main steps to gather, feed-back and analyze data, and to plan, implement and evaluate action; a meta-step to monitor. These phases are modeled in the framework as explained in the next paragraphs.

4.1 Understanding the context and purpose

The first phase in the AR concern to understand the referring environment and to identify the purpose, square number 1 in Fig. 2, both of the action and of the research. In so doing, this pre-step is driven by two questions concerning the rationale for action and for research [13]. The contexts of the research are the Enterprise Networks (ENs), in particular business networks, that are collaborative stable environments in which companies work together with a long term vision, however maintaining their own independence. The purpose of the research is to develop a structured methodology that allows ENs to manage knowledge in order to achieve the benefits mentioned in previous paragraphs.
On the other hand, the context of the specific action is a particular typology of EN, which presents a structure characterized by the presence of the Virtual Development Office (VDO) subject [5]. It is an independent subject, acting as a leading actor, and it has the role of creating, coordinating and managing a community of enterprises, managing also the innovation activity and the collaborative research and development. The leader actor in the network chosen for the AR is called Gruppo Poligrafico Tiberino (GPT) [49]. The VDO should do what individual SMEs typically do not. Particularly, it should be the market intelligence of the network, continuously catching Business Opportunities (BOs) in the market and positioning the network on it. This means that the VDO should not act as a global commercial office of the network, while it should look for integrated and complex Collaborative Business Opportunities (CBOs), that single companies could not be able to acquire, constituting the so called Virtual Enterprises (VEs) or Virtual Organizations (VOs) to perform them [5]. The VDO represents the network not only in terms of critical mass, but also in terms of a different and unique offer to the market, that can be achieved exclusively through a network approach which enhances and optimizes companies capabilities and collaboration. Moreover its market intelligence role, the VDO is the permanent interface to public institutions, financial institutions and research centers.
These aspects are particularly emphasized if institutional subjects support the VDO bridging the gap between industrial and institutional worlds. In the AR case, the support for GPT is represented by the university spin-off named Netvalue, that proactively develop new researches, theories and models for the network

management, thanks to the strong relationships with the Universities and Research Centers.
The VDO model can be seen as an evolution of the actual long-term CN frameworks, that, coherently with the classification carried out by [7], could be affiliated under the more general Virtual Organizations Breeding Environment (VBE). The VDO, with respect to more general form of VBEs, it is focused in particular on innovative businesses and it is characterized, as above mentioned, by the presence of a central leading entity. If we make a comparison between VDO and VBE a higher degree of coordination can be observed because of the presence of the VDO entity [8]. There is an increasing demand in the industrial world to concretely implement new forms of collaborations, and the VDO model is one of the most promising for the evolution of pre-existent form of clusters or consortiums, which want to develop to more efficient forms of collaboration [53].

4.2 Data gathering, analysis and feedback: KPIs identification and analysis

In order to evaluate the impact of the KM implementation within the EN, the action researchers, i.e. the authors in this case, need to identify and analyze the set of Key Performance Indicators (KPIs) mainly influenced by the KM adoption (square number 2 in Fig. 2). This is a fundamental phase since it allows the researchers to validate, refine or change the Critical Success Factors (CSFs) for implementing a KMS identified in the next step, analyzing if the KPIs are positively/negatively influenced. An assessment of the KPIs before and after the KMS implementation is thus required. For the collaborative nature of the AR context, authors have identified two main Performance Measurement Systems: one for the global network environment, and another for the single company.
Regarding the global system, in order to analyze the effectiveness of the CSFs for a KMS (identified in the square number 3 in Fig. 2), the authors adopted the KM Balanced Scorecard (KMBSC) proposed by [6]; as the [32] classic Balance Scorecard (BSC) approach, the KMBSC provides a technique to balance long-term and short-term objectives, financial and non-financial measures, leading and lagging indicators, and internal and external perspectives. The typical dimensions, i.e. customer, financial, internal business, and learning and growth, have been adapted in KMBSC to assess current state of KM and evaluate the impact of initiatives in this area [31]. In so doing, the authors adapted the classical BSC dimensions with five new measurement areas of interest, the most significantly related and influenced by the implementation of a KMS (see Table 2). The data gathering details and the analysis of the proposed performance dimensions in the KMBSC and the F functional are presented in the KPIs assessment phase (square number 5 in Fig. 2), in which the authors propose a comparative analysis between the indicators before and after the KMS implementation.
Instead, the system for the KPI evaluation and assessment for the single company was developed to investigate if the performances of the network could somehow influence the performance of the single company and thus if there is a correlation between these two dimensions. This aspect is particularly important since it could allow the authors to affirm that the more the network performance increases the more the performance of the single company could be higher. The PMS designed for the performance measurement of the single companies, as independent actors, take in consideration the KPIs mostly used in accounting (ROI, ROE, turnover, etc.): the KPI set is presented in section 4.5.

4.3 Action planning: Identification of the CSFs and communication to the network

In the action planning phase (square number 3 in Fig. 2) the authors identified a set of Critical Success Factors (CSFs) for effective implementation of the KMS within the EN. A communication phase of the identified CSFs and their importance to the network follows.
Literature on a KMS implementation in collaborative environment is very scarce and no articles investigate the CSFs for ENs; the approach adopted by the authors is therefore to adapt the identified CSFs for implementing a KMS within a single company, adding new factors specifically for ENs, and using the AR case study for theory extension and refinement [58]. The evaluation of the identified CSF impact on the network performance (square 5 in Fig. 2) is therefore an important phase in order to assess the CSF set, since they are defined as "areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation" [48]. In terms of KM, they can be viewed as those activities and practices that should be addressed in order to ensure its successful implementation [63].
Regarding the CSFs for single companies, several works in literature highlights common aspects.

For example, [51] identified seven key factors, such as knowledge leadership, knowledge creating and sharing culture, a well-developed technology infrastructure, strong link to a business imperative, a compelling vision and architecture, systematic organizational knowledge processes and continuous learning. [28] highlighted five dimensions as critical for implementing a KM system: leadership, measurement, control, coordination and resources. [15] extended the research to nine CSFs, that are senior management support, knowledge-friendly culture, technical infrastructure, standard and flexible knowledge structure, clear purpose and language, link to economic performance or industry value, organisation infrastructure, multiple channels for knowledge transfer and change in motivational practices. Seven similar key factors had been recognized by [36]; in particular, he pointed out that senior leadership support, a supportive culture, knowledge ontologies and repositories, KM systems and tools, a KM strategy, a chief knowledge officer or equivalent and a KM infrastructure, and incentives to encourage knowledge sharing, are fundamental for implementing a KM system. [25] accepted five categories of CSFs, such as leadership, culture, Information Technology (IT) infrastructure, structure/roles/responsibilities and measurement. The American Productivity & Quality Center [2] listed five milestones: leadership, culture, technology, strategy and measurement. Finally, [63] defined a set of eleven CSFs, merging the previous findings. The resulting CSF grouping is constituted by management/leadership/support, culture, IT, strategy and purpose, measurement, organizational infrastructure, processes and activities, motivational aids, resources, training/education and HRM. By integrating the common factors extending them to a collaborative environment and merging others, the authors propose a comprehensive model of 10 factors for implementing KM in ENs. It is important to affirm that the CSFs proposed by the authors are to be considered as general for the network environment, and not specific for each single company. For those, the CSFs already proposed in literature continue to be still valid.
The proposed CSFs for establishing a KMS in ENs are:

1. leadership and support from the network central actor;
2. a sharing culture;
3. a common or diffused IT system;
4. global aligned strategies and purposes;
5. a global measurement system;
6. network infrastructure;
7. processes and activities;
8. partners' motivational aids from the network central actor;
9. resources;
10. Human Resource Management (HRM);

Each factor is described in detail in Table 3.
The processing and the communication of the identified CSFs to the companies belonging to the network is performed by the leading actor, i.e. the VDO. Actually, in the AR, this subject is GPT, which has been supported by the authors. Communicating the importance and relevance of the 10 CSFs and how to implement each of them is a long and time consuming process; there should be a cultural change in entrepreneurs and in partners' employees towards a KM vision. Several meetings with the companies of the network are required: in the Si.Ca.RT case study the action researchers often met the company's management, through reunions, brainstorming, meetings, etc during a five-month period, in order to transfer the principles of each CSF.

4.4 Implementation

In order to design and implement an effective KMS, the authors firstly identified the requirements the system should accomplish. The most important needs of the network are [52]:

- NEED 1 - Within VDO Networks, the main hub, i.e. the VDO, has knowledge management issues related to the fact that it has to quickly and successfully respond to new Business Opportunities and therefore it needs to know the network members' competences and capabilities. Therefore, a KMS, in this case, has also the role of supporting decision-making activities.
- NEED 2 - SMEs can acquire new knowledge by participating in partnerships or networks with other companies, sharing similar or complementary problems in order to become more competitive. This raises the issue of how to facilitate the operation of such networks. Therefore, sharing knowledge about the implementation and outcomes of projects among the VDO Network members should promote the implementation of similar and new initiatives to improve their competitive position.
- NEED 3 - SMEs have poor managerial competences and scarce know-how of

technological innovations. Consequently, the KMS should be a support in these issues, by helping to promote managerial best practices and sharing of technological know-how within the network.

- NEED 4 - SMEs desire to use simple tools, with easy user interfaces and the possibility of managing documents, drawings, procedures, spreadsheets, etc..
- NEED 5 - SMEs do not have the resources for investing in informatics infrastructures for implementing new tools. As a consequence of that, tools based on Internet knowledge portals are desired.

Coherently with the CSFs described in paragraph 4.3, the KMS has been implemented in the GPT Enterprise Network following the system proposed by [52], that integrates five main functions in answering the previous needs. In particular:

1. system consisting in a virtual space that contains electronic library of documents and information about the main cases/projects by main attributes: company, manufacturing sector, manufacturing group, country and subject;
2. structured directory of network companies;
3. resources on the VDO and Network as overall;
4. resources of common interest such as journals, conferences, forum etc; and
5. library of management resources (technologies and management best practices).

4.5 KPIs assessment and Critical Success Factor validation

In order to evaluate the implemented KMS, the assessment of the main performance indicators is a key activity. This phase has been conducted considering both the network dimension both the single company dimension.

4.5.1 KPI Assessment for the network evaluation

For the first dimension, starting from the results coming from [6] and updating the results until 2011, the following tables clarify the main results achieved and how the main KPIs have increased after the KMS implementation in the enterprise network.

Tables from 3 to 8 show aggregate results from the questionnaire submitted to the 21 companies belonging to the GPT network. The following dimensions discussed in the previous section are considered: Competitiveness (Table 3), Cost Reduction (Table 4), Learning (Table 5), Innovation (Table 6), Environment (Table 7) and Financial Performance (Table 8). Because results are reported in aggregated form, average values of ΔTurnover are still low. In reality, the collaboration opportunities created by the VDO have not yet involved all the companies, because some of them joined the network only recently. However, the greater contribution to the turnover increase comes from new clients in new geographical areas and in new sectors. Cost reduction comes especially from services and products procurement. It has been observed that services procurement (like IT services) discounts have been easily obtained even though the collaborative procurement of companies belonging to different sectors, while products procurement discount are favored for companies in the same sector (e.g. the purchasing of the same type of material). The learning dimension is the one that shows highest improvements due to network collaboration. New technological opportunities in manufacturing processes (e.g. printing machines renewal) have been taken up thanks to the possibility to take advantage of public funding specifically addressed to companies aggregations. Furthermore, the capability of attracting funds from banks and credit institutions has also increased, thanks to the possibility to show in an aggregate form the financial statements of the companies. From results regarding the innovation dimension, it is evident that companies adhering to the network recognize the fundamental role played by the VDO in stimulating all the innovation aspects. However, it also emerges that new products and services development has been promoted by internal companies, customers and suppliers. In the questionnaire table submitted which relates to the network environment evaluation, each company had to indicate the companies with which it had some form of relationship (products trading, technological and market related information exchanges, projects). Table 7 shows aggregate results, in which relationships with the VDO are also represented. VDO is involved in almost all the network activities about projects and economic/market related information exchanges. A few products trading activities among companies are also observed.

Since GPT is a very recent network, the financial performances are still marginally influenced by those belonging to the collaborative environment. It is also important to underline that the parameters considered in Table 8 are averaged

values; this means that even if four companies scored a 1-25% ROI increasing, the other companies' low values decrease the total averaged score. However, the Financial Performance perspective is one of the most important dimensions to take in consideration for further analysis, where also the financial parameters will be strongly increased by the network business. Several projects are starting and this allows the authors to speculate the financial parameters will be strongly influenced in the next years.

4.5.2 KPI Assessment for the single company evaluation

In order to evaluate the benefits for the single company, when they occurred, coming from those belonging to the VDO collaborative network, some indicators have been analyzed. Only a financial analysis has been performed by the authors, but it is sufficiently relevant for preliminarily validating the KMS introduced in the GPT network. The most common financial KPIs have been analyzed since 2008 (KMS not yet implemented) and 2011 (KMS activated from 2 years). The following tables represent the most influenced indicators for Si.Ca.RT company. The KMS was implemented in GPT in 2009; particularly interesting is thus that the indicators detected in Si.Ca.RT are positively influenced as of 2009 up to nowadays. It is not possible to ascertain that the presented positive results are directly related to the KMS implementation in the GPT network; nonetheless a correlation between them could be studied, considering that the company competitiveness is increased by those belonging to the network, in terms of performed business opportunities and turnover, also during these years of economic crisis. It is moreover absolutely verifiable that the performance of the network has increased in the last years [6], after the KMS implementation.

4.5.3 Critical Success Factors validation

The positive results achieved through the Action Research (AR) conducted by the authors allow to partially validate the Critical Success Factors identified at the beginning of the research.Since actually only a first cycle of the AR has been performed, it is not possible to directly assign a weight to every single CSF on the network and company performances. More cycles need to be run, including new CSFs or excluding the existing ones, and then verify how the performance could change. However, in the authors' opinion, a research answer could be provided using the four most influencing CSFs:

"to promote an effective KMS in an EN is fundamental to promote *a sharing culture* stimulated through a *partners' motivational aids from the network central actor* using the tool of a *common or diffused IT system* performed and powered by the *Human Resource component*".

After the first cycle, the authors proposed three new CSFs to be validated, after the performance assessment, described in :

1. training and education from the network central actor;
2. environmental influences;
3. coordinated marketing and network image.

New AR cycles can allow the authors to definitely validate the most appropriate set of CSFs for the GPT network.

5 Conclusions

The paper formalizes an Action Research for implementing a Knowledge Management System in an Enterprise Network environment. For effective implementation, the authors identified some Critical Success Factors, validated through the assessment of the most important Key Performance Indicators related to both the global network both to the single company dimension.
A Knowledge Management System has been implemented in a company belonging to a particular form of Enterprise Network, the Virtual Development Office (VDO). As outlined by the results from the case study, this type of network receives a very positive influence from the implementation of an effective KMS. In fact, realization and coordination of VO are concentrated in a central entity (the VDO) which has a great benefit from using knowledge-based decision supporting tools that assists the VO's planner in its activities (competences mapping, partners selection etc.). At the same time, this type of network form provides many favourable success factors for the effective implementation of a KMS. In fact in a collaborative environment among companies, Knowledge Management is also related with trust management. The delicacy of the latest issues makes preferable both these aspects to be handled, at the network level, by a specialized entity, rather than by a network member that changes every time, as in other form of networks. By assuming the permanent role of

VOs planner and coordinator, the VDO can assure the required level of competences and experience also in exploiting all the KMS capabilities, in performing training and education activities towards networks' members, while maintaining the required level of trust among partners. The very positive results achieved from the first cycle of the Action Research supply a first set of CSFs for next cycles of further research. The approach proposed in the paper is generic for collaborative environments, and thus valuable also in different case studies. The next steps of our research activity will consist in the application of the proposed approach to network environments related to different sectors. In particular we are working with two companies, one in the furniture sector (Porada s.r.l) and the other one in the power electronic sector (Elettromil s.r.l.), around which two networks are growing, that will offer the possibility to further validate and possibly improve the proposed framework.

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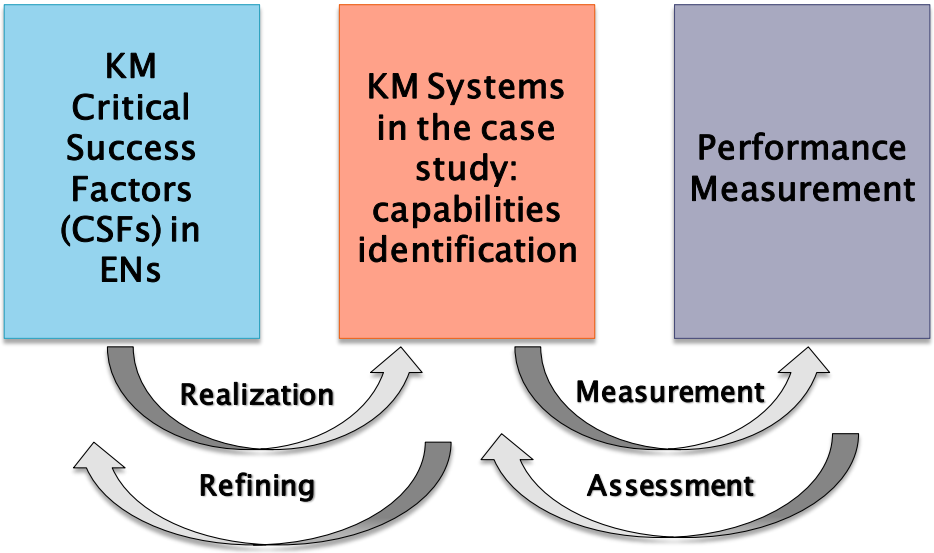

Fig. 1: the goal of the research.

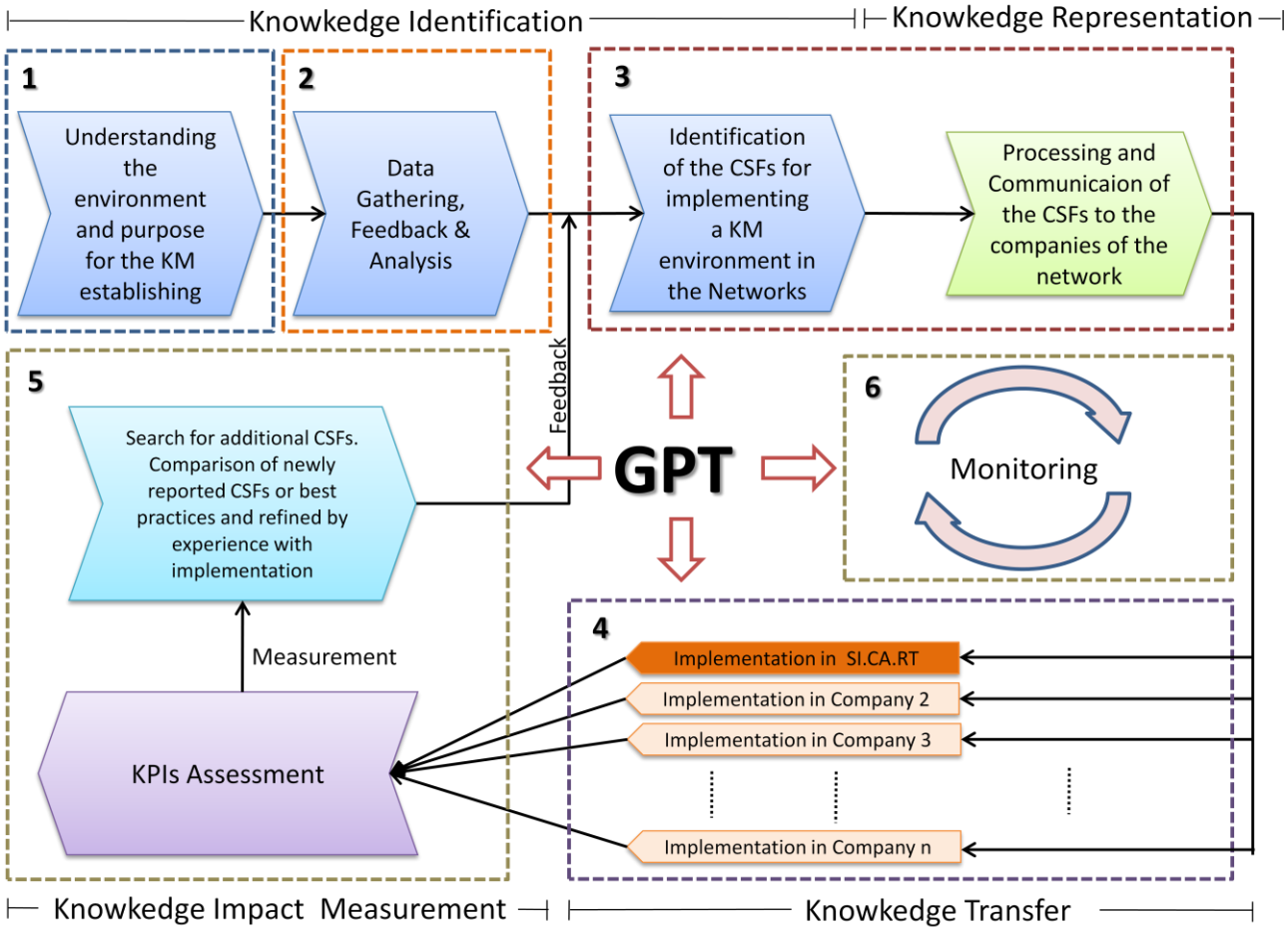

Fig. 2: the Knowledge Management System for the GPT network and the Si.Ca.RT KMS implementation

Table 2: KMBSC performance measurement dimensions

BSC Dimensions	KMBSC Dimensions	Sub-Dimensions		References
Financial	**Cost Reduction**	Internal Processes Cost Reduction		Holsapple and Wu, (2008).
		Product/Service Purchasing cost reduction		
		Product/Service Commercialization cost reduction		
		Manufacturing Process Cost Reduction		
	Network's Objective: Financial Performance	ROI		McDermott, (2002); King and Ko, (2001); Laitamaki and Kordupleski, (1997).
		EDIBTA		
		ROS		
		ROE		
Internal Business	**Environment**	Infrastructure	Network Technology development	Holt *et al.*, (2004).
			Technology Information Share	
			Support as vehicle for information Sharing	
		Collaboration	Economical and Market Information	
			Share Projects with partners	
			Commerce of goods	
			New partner relationships	
		Network Model	Network Development	
			General companies' relationships	
Learning and Growth	**Innovation**	Business Model		Johannessen, (2008); Lundvall and Nielsen, (2007); Park and Kim, (2006).
		New Product development		
		Investments		
		New Service development		
	Learning	Knowledge Circulation Process		Lee *et al.*, (2005).
		Increase of Technological know-how related to manufacturing processes		
		Increase of Knowledge related to new product/service development		
		Increase of knowledge of markets and customers		
		Increase in the capability of attracting funding		
Customer	**Network's Objective: Competitiveness**	Turnover created by the Network: Δ Existing Customers		Holsapple and Wu, (2008).
		Turnover created by the Network: Δ New Customers		

Table 3: CSFs, details and objectives

CSFs	General EN context: CSF details and objectives
Leadership and support from the network central actor	~ Network leader as role model, it shares and offers its knowledge freely to the network ~ Network leader continuously learning and looking for new ideas ~ Influence on partners in KM activities and steering the change effort ~ Conveying the importance of KM to the partners, maintaining the partners' morale and creating a culture that promotes knowledge sharing and creation
A sharing culture	~ Core beliefs, values, norms and social customs that govern the way companies act and behave in the network ~ It highly values knowledge and encourages its creation, sharing and application ~ Collaboration among partners is a crucial aspect of such a culture ~ Trust among partners is a fundamental aspect of a knowledge culture ~ Culture in which partners are constantly encouraged to generate new ideas, knowledge and solutions ~ Culture problem seeking and solving oriented ~ Openness culture with mistakes openly shared
A common or diffused IT system	~ Connector of human to information, as human to another, as a company to information and as a company to other partners ~ Rapid search, access and retrieval of information ~ Support for collaboration and communication among partners ~ It should be simple in technology, easy to use, suitable to companies' needs, standardized in knowledge structure
Global aligned strategies and purposes	~ Clear and well-planned global strategy ~ Strategy should be well adjusted to the situation and context of the network in hand ~ KM strategy should be linked or integrated with the network business strategy ~ Compelling and shared vision for pursuing KM: partners should support this vision ~ Clear objectives, purposes and goals need to be set and understood by all the partners of the network
A global measurement system	~ Measuring KM impact is necessary in order to ensure that its envisioned objectives are being attained ~ Measurement enables organizations to track the progress of KM and to determine its benefits and effectiveness ~ It provides a basis for organizations to evaluate compare, control and improve upon the performance of KM ~ Measurement is also needed to demonstrate the value and worthiness of a KM initiative to the network leader ~ Traditional hard measures supplemented by soft, nonfinancial measures in order to provide a more holistic approach to measure KM
Network infrastructure	~ Central aspect for implementing KM is the development of an appropriate network infrastructure ~ Establishing a set of roles and teams to perform KM tasks, a group of people with formal responsibilities for KM ~ Leading actor as knowledge transfer and manager for the partners
Processes and activities	~ The execution of KM processes lies at the heart of creating a successful knowledge-based enterprise ~ It is important that the network adopt a process-based view to KM, managed by the leading actor of the network ~ Four main processes knowledge related: creation, storage/retrieval, transfer and application ~ Appropriate interventions and mechanisms need to be in place in order to ensure that KM processes are addressed in a systematic and structured manner in the network ~ Coordination of the KM processes by the central actor ~ Processes and activities incorporated into partners' daily work activities so that they become common practices, diffused in the network

Partners' motivational aids from the network central actor	~ Lead actor should establish the right incentives, rewards or motivational aids to encourage companies to share and apply knowledge ~ In building a knowledge-based network, incentive systems should be focused on knowledge sharing and contribution, teamwork, creativity and innovative solutions ~ Partners should seek and contribute knowledge, through incentives based on goals that they can influence but not achieve on their own ~ Partners' motivation by the central actor actions
Resources	~ Financial support is inevitably required for KM investments by the partners ~ Human resources are needed to coordinate and manage the implementation process as well as to take up knowledge-related roles ~ Time is also a consideration: partners have to free up time for their employees to perform KM network activities such as knowledge sharing ~ Providing time and opportunities for people to learn is important ~ Attention management in the network as facilitator of KM initiatives
Human Resource Management (HRM)	~ People are the sole originators of knowledge ~ Effective recruitment of partners and employees is crucial because it is through this process that knowledge and competences are brought into the network ~ Partners and employees development is seen as a way to improve and enhance the value of companies and individuals: their skills and competences need to be continuously developed ~ Retaining knowledge from being lost, through providing opportunities for employees of the network to grow and to advance their careers

Table 3: Network's Objective: Competitiveness.

	Δ Turnover Pre-existing customers	Δ Turnover New clients, pre-existing geographical area	Δ Turnover New clients, new geographical area	Δ Turnover New clients, pre-existing sector	Δ Turnover new clients, new sector
0%	X				
< 1%		X		x	
1% - 25%			x		x
25% - 50%					
50% - 75%					
75% - 100%					

Table 4: Cost Reduction.

	Costs reduction in products and services procurement	Costs reduction in products/services trading	Costs reduction in the manufacturing production	Costs reduction in other internal processes
0%				
< 1%		x	x	
1% - 25%	x			x
25% - 50%				
50% - 75%				
75% - 100%				

Table 5: Learning

	Knowledge improvement on technological opportunities in manufacturing processes	Knowledge improvement on clients and markets	Increasing in the attracting funds capability	Knowledge Circulation	Knowledge improvement related to innovation in products/ processes/services
0%					
< 1%					
1% - 25%	x	x			x
25% - 50%			x	x	
50% - 75%					
75% - 100%					

Table 6: Innovation

	New products development	New services development	Investments	Business model
Suggested by internal company	x			
Suggested by supplier		x		
Suggested by client	x	x		
VDO	x	x	x	x
Other			x	

Table 7: Environment

	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7	Company 8	Company 9	Company 10	Company 11	Company 12	Company 13	Company 14	Company 15	Company 16	Company 17	Company 18	Company 19	Company 20	VDO
Products trading	5	-	-	2	-	-	3	-	1	-	5	-	4	-	1	-	-	6	1	8	-
Technological information exchange	2	2	-	-	4	-	3	-	6	-	4	2	-	1	-	3	3	-	5	3	-
Economic/market related information exchange	6	8	5	5	3	4	4	3	8	7	1	5	6	3	4	4	3	4	3	1	18
Projects	-	3	-	2	-	4	4	-	-	-	2	-	4	-	4	4	-	2	3	3	12

Table 8: Network's Objective: Financial Performances.

	ROI	EDIBTA	ROS	ROE
0%				
< 1%	x	x	x	x
1% - 25%				
25% - 50%				
50% - 75%				
75% - 100%				

Table 9: the most influenced financial indicators

1. Turnover				
12/2008: € 7.569	**12/2009:** € 7.264	**12/2010:** € 8.033	**12/2011:** € 9.123	
100,0%	*100,0%*	*100,0%*	*100,0%*	
2. Added Value				
12/2008: € 1.623	**12/2009:** € 1.649	**12/2010:** € 2.164	**12/2011:** € 2.217	
21,4%	*22,7%*	*26,9%*	*24,3%*	
3. EBITDA				
12/2008: € 1.037	**12/2009:** € 1.004	**12/2010:** € 1.413	**12/2011:** € 1.400	
13,7%	*13,8%*	*17,6%*	*15,3%*	
4. Finance charges				
12/2008: -€ 400	**12/2009:** -€ 305	**12/2010:** -€ 229	**12/2011:** -€ 252	
-5,3%	*-4,2%*	*-2,8%*	*-2,8%*	
5. Net Profit				
12/2008: -€ 44	**12/2009:** € 142	**12/2010:** € 19	**12/2011:** € 314	
-0,6%	*1,9%*	*0,2%*	*3,4%*	

Table 10: new CSFs, details and objectives

CSFs	General EN context: CSF details and objectives
Training and education from the network central actor	~ Proper basic training provided by the leading actor to the partners for better understanding the KM concepts and framing a common language ~ Partners trained and educated in using the KM system and other technological tools for managing knowledge ~ Skills development should occur in communication, networking, peer learning, team building, collaboration and collaborative creative thinking
Environmental influences	~ The leading actor and the partners should catch information, know-how, skills from the external environment ~ Leading actor as bridge for internal network and external institutions, research centers, universities, etc. ~ Politics for intellectual protection ~ Benchmarking with other similar realities
Coordinated marketing and network image	~ The network should develop a coordinated marketing managed by the central actor ~ The partners of the network should perceive the importance of using a coordinated network image